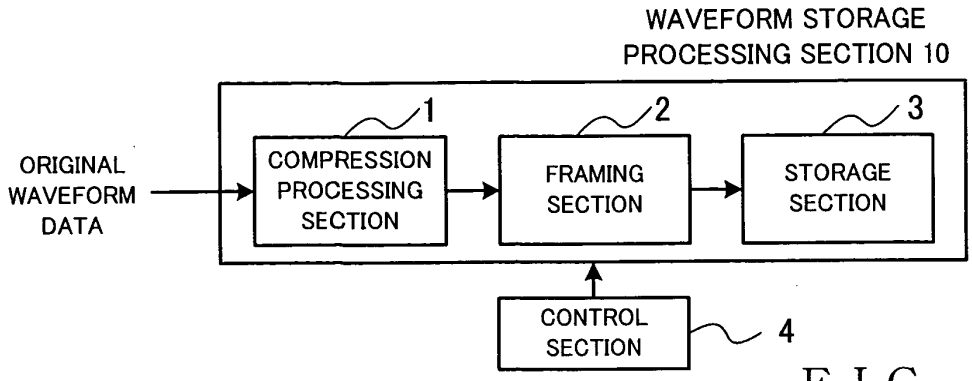
WAVEFORM STORAGE
PROCESSING SECTION 10
ORIGINAL
WAVEFORM
DATA
COMPRESSION
PROCESSING
SECTION
1
FRAMING
SECTION
2
STORAGE
SECTION
3
CONTROL
SECTION
4

FIG. 1

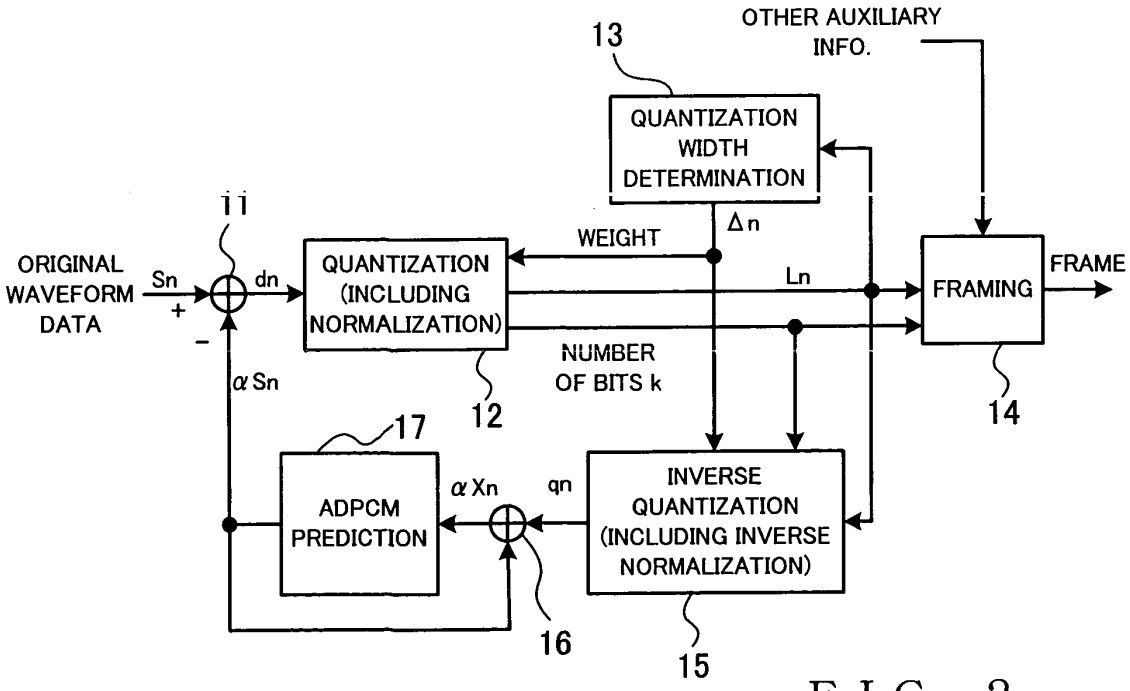
OTHER AUXILIARY
INFO.
13
QUANTIZATION
WIDTH
DETERMINATION
Δn
WEIGHT
11
ORIGINAL
WAVEFORM
DATA
Sn
+
−
dn
QUANTIZATION
(INCLUDING
NORMALIZATION)
Ln
FRAMING
FRAME
NUMBER
OF BITS k
αSn
12
14
17
ADPCM
PREDICTION
αXn
qn
INVERSE
QUANTIZATION
(INCLUDING INVERSE
NORMALIZATION)
16
15

FIG. 2

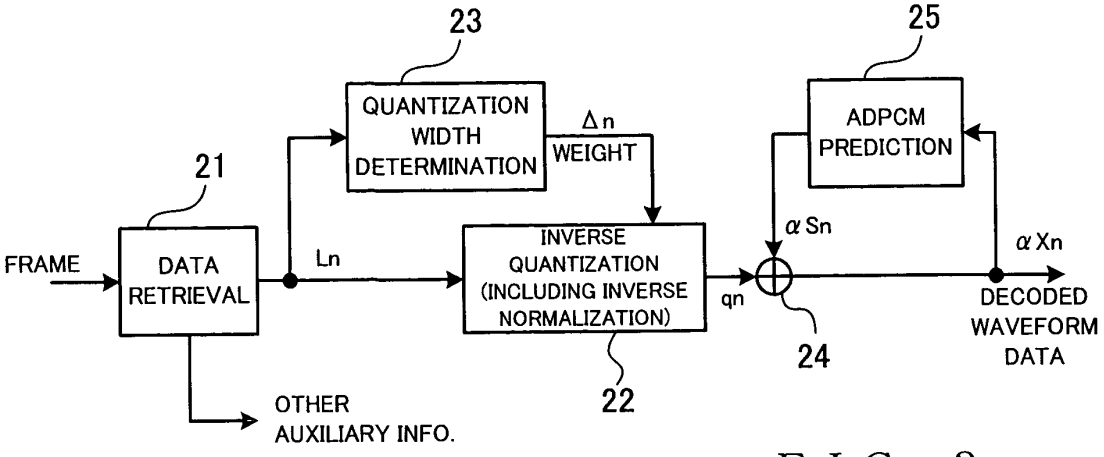
23
25
QUANTIZATION WIDTH DETERMINATION
Δn
WEIGHT
ADPCM PREDICTION
21
FRAME
DATA RETRIEVAL
Ln
INVERSE QUANTIZATION (INCLUDING INVERSE NORMALIZATION)
αSn
αXn
qn
24
DECODED WAVEFORM DATA
22
OTHER AUXILIARY INFO.

FIG. 3

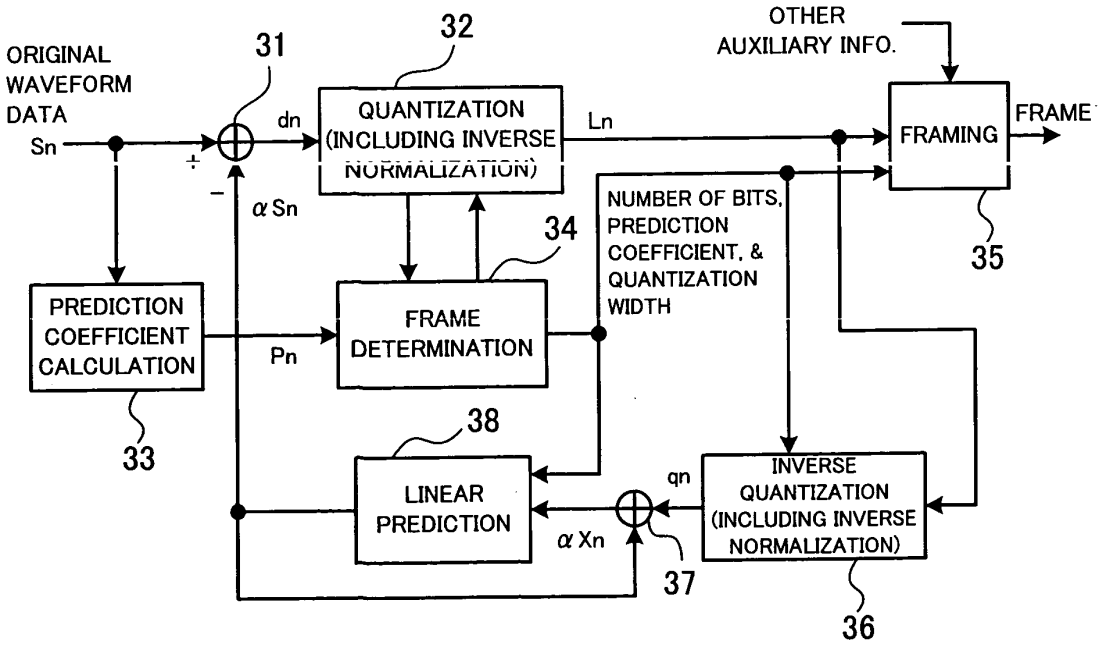
ORIGINAL WAVEFORM DATA
Sn
31
32
dn
QUANTIZATION (INCLUDING INVERSE NORMALIZATION)
Ln
OTHER AUXILIARY INFO.
FRAMING
FRAME
αSn
34
NUMBER OF BITS, PREDICTION COEFFICIENT, & QUANTIZATION WIDTH
35
PREDICTION COEFFICIENT CALCULATION
Pn
FRAME DETERMINATION
33
38
LINEAR PREDICTION
qn
INVERSE QUANTIZATION (INCLUDING INVERSE NORMALIZATION)
αXn
37
36

FIG. 4

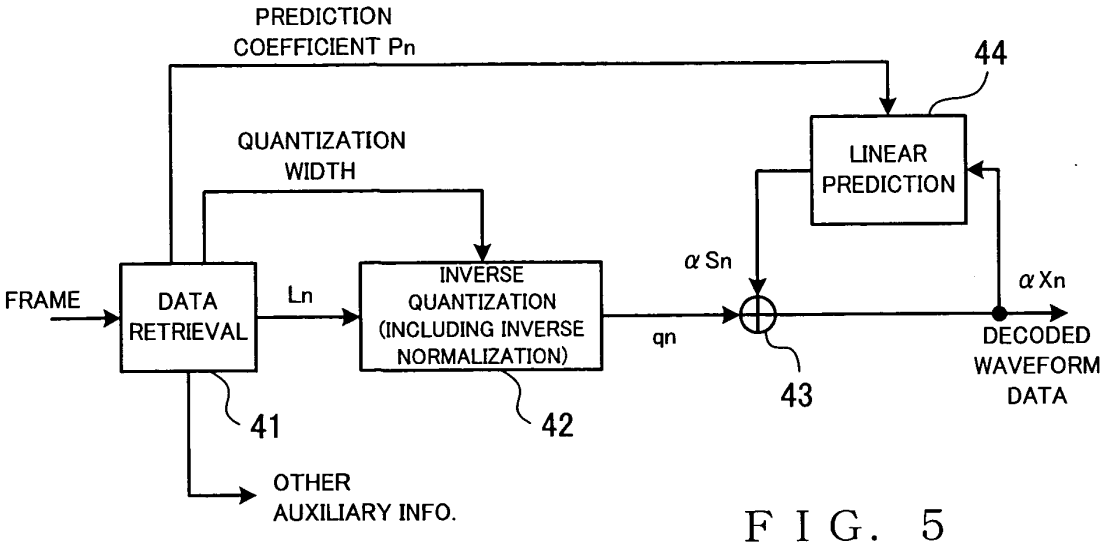
PREDICTION
COEFFICIENT Pn
44
QUANTIZATION
WIDTH
LINEAR
PREDICTION
FRAME
DATA
RETRIEVAL
Ln
INVERSE
QUANTIZATION
(INCLUDING INVERSE
NORMALIZATION)
α Sn
α Xn
qn
DECODED
WAVEFORM
DATA
41
42
43
OTHER
AUXILIARY INFO.

FIG. 5

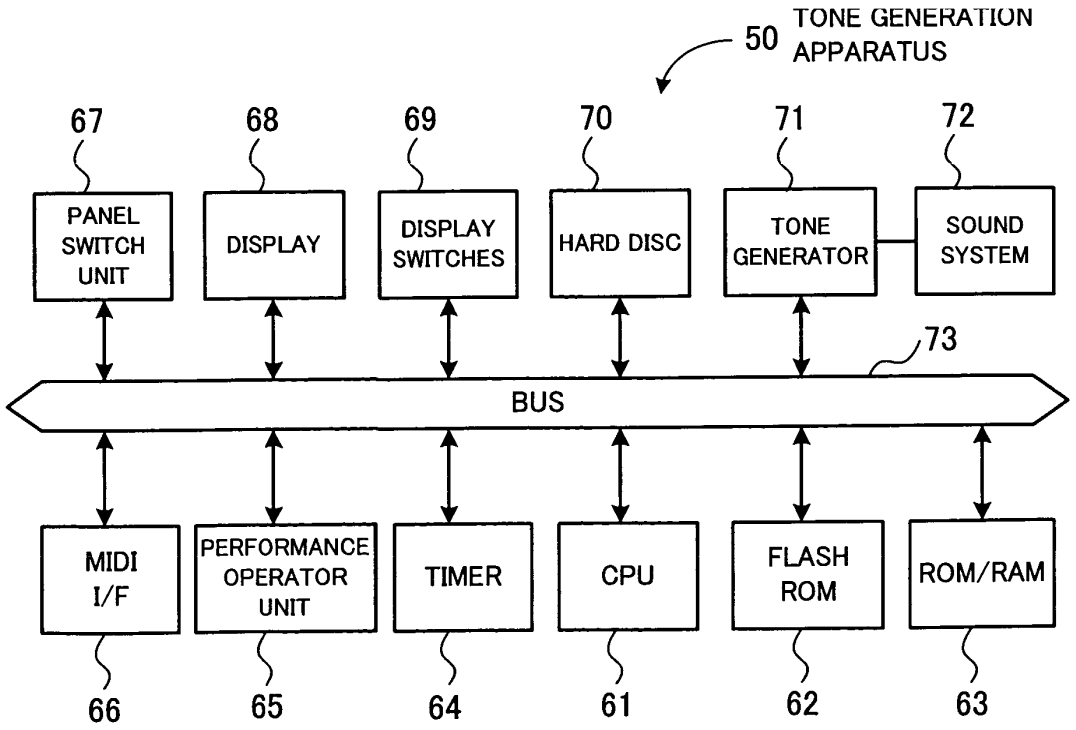
50
TONE GENERATION
APPARATUS
67
68
69
70
71
72
PANEL
SWITCH
UNIT
DISPLAY
DISPLAY
SWITCHES
HARD DISC
TONE
GENERATOR
SOUND
SYSTEM
73
BUS
MIDI
I/F
PERFORMANCE
OPERATOR
UNIT
TIMER
CPU
FLASH
ROM
ROM/RAM
66
65
64
61
62
63

FIG. 6

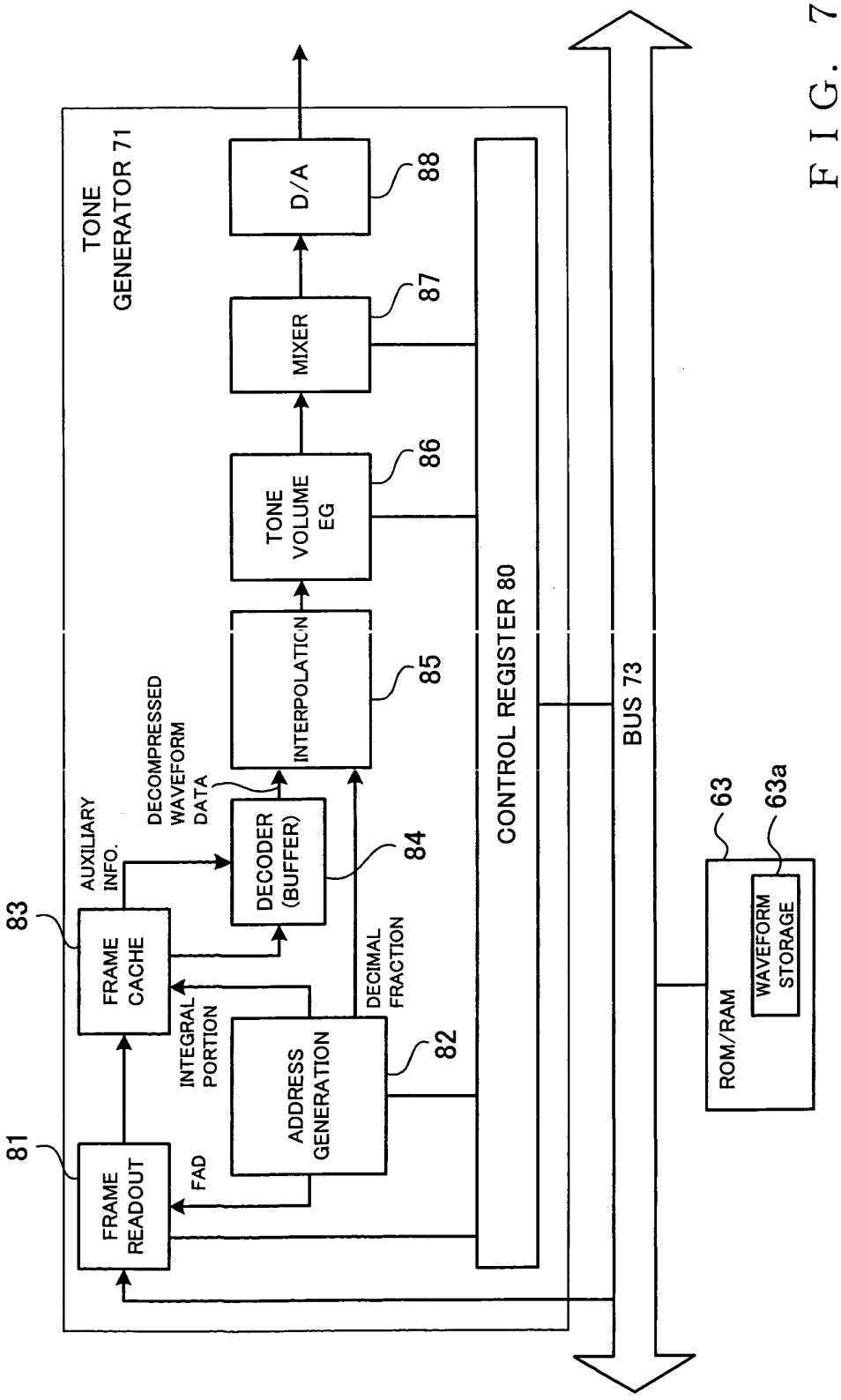
TONE GENERATOR 71
D/A
88
MIXER
87
TONE VOLUME EG
86
INTERPOLATION
85
DECOMPRESSED WAVEFORM DATA
AUXILIARY INFO.
DECODER (BUFFER)
84
83
FRAME CACHE
INTEGRAL PORTION
DECIMAL FRACTION
ADDRESS GENERATION
82
81
FRAME READOUT
FAD
CONTROL REGISTER 80
BUS 73
63
63a
ROM/RAM
WAVEFORM STORAGE

FIG. 7

2 BITS

00	PREDICTION COEFFICIENT						QUANTIZATION WIDTH
01	NUMBER OF BITS	1	2	3	4	5	6
02	7	8	9	10	11	12	13	14
03	15	16	17	18	19	20	21	22
04	23	24	25	26	27	28	29	30

3 BITS

00	PREDICTION COEFFICIENT					QUANTIZATION WIDTH
01	NUMBER OF BITS	1	2	3	4	
02	5	6	7	8	9	
03	10	11	12	13	14	15
04		16	17	18	19	20

4 BITS

00	PREDICTION COEFFICIENT			QUANTIZATION WIDTH
01	NUMBER OF BITS	1	2	3
02	4	5	6	7
03	8	9	10	11
04	12	13	14	15

5 BITS

00	PREDICTION COEFFICIENT			QUANTIZATION WIDTH
01	NUMBER OF BITS	1	2	
02	3	4	5	6
03		7	8	9
04		10	11	12

6 BITS

00	PREDICTION COEFFICIENT			QUANTIZATION WIDTH
01	NUMBER OF BITS	1	2	
02	3	4	5	
03		6	7	
04	8	9	10	

10 BITS

00	PREDICTION COEFFICIENT		QUANTIZATION WIDTH
01	NUMBER OF BITS	1	
02	2	3	
03		4	
04	5	6	

FIG. 8

00	NUMBER OF BITS	1	2	3
01	PREDICTION COEFFICIENT	4	5	6
02		7	8	9
03		10	11	12
04		13	14	15
05		16	17	18
06	QUANTIZATION WIDTH	19	20	21
07		22	23	24
08	OTHERS	25	26	27
09		28	29	30

FIG. 9

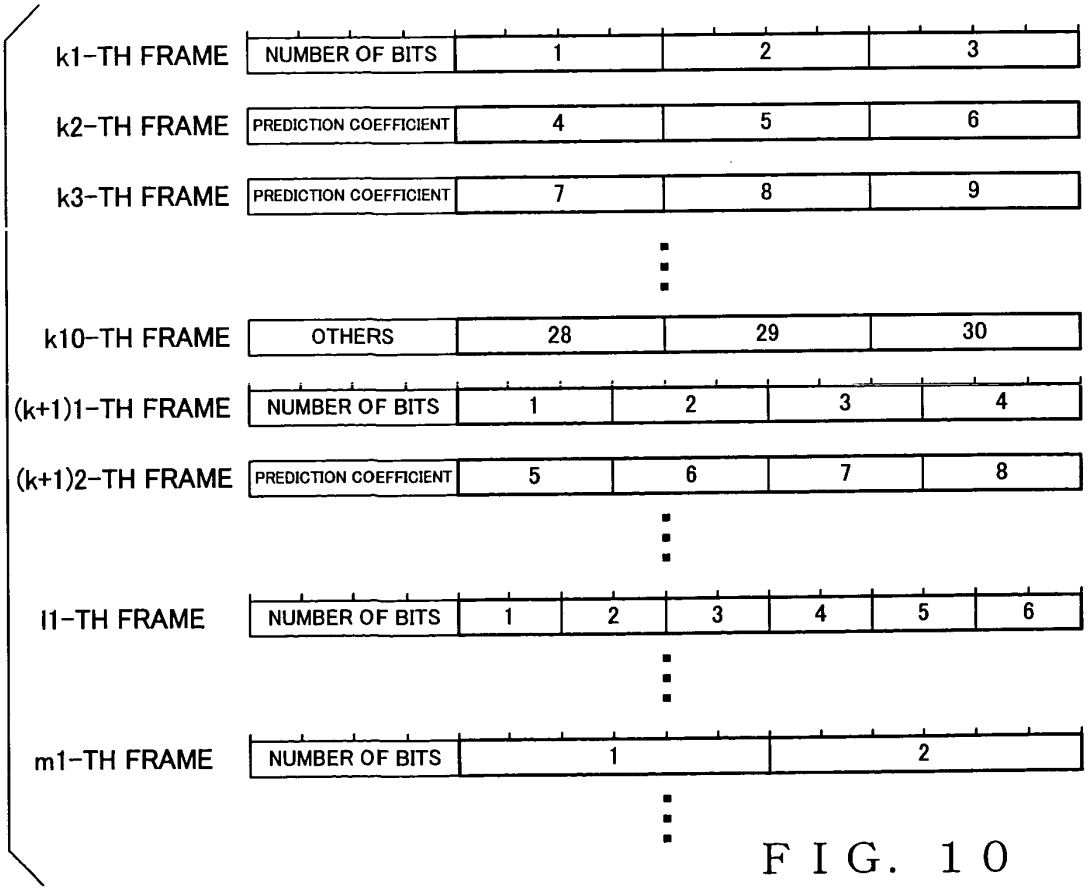

FIG. 10

00	PREDICTION COEFFICIENT	1	2	3
01		4	5	6
02		7	8	9
03		10	11	12
04		13	14	15
05	NUMBER OF BITS	16	17	18
06	QUANTIZATION WIDTH	19	20	21
07		22	23	24
08	OTHERS	25	26	27
09		28	29	30

FIG. 11

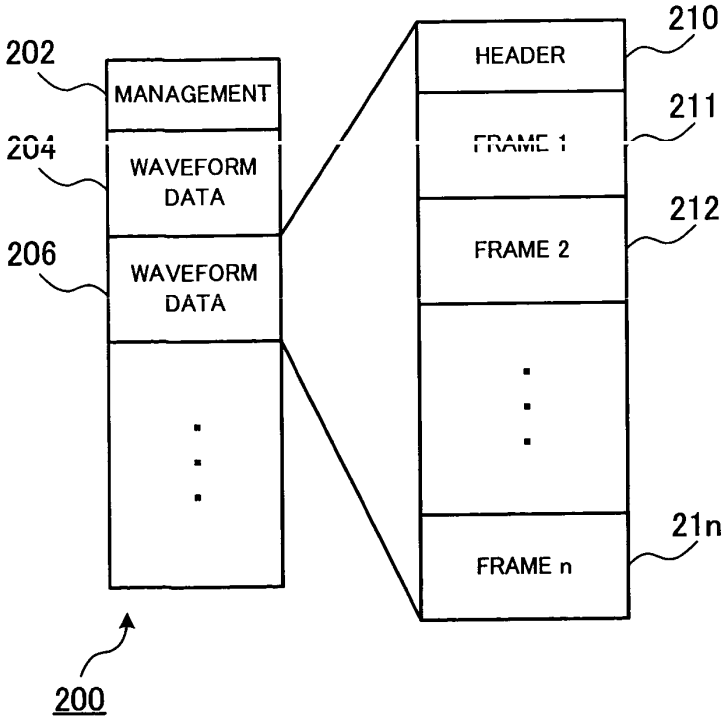

FIG. 13

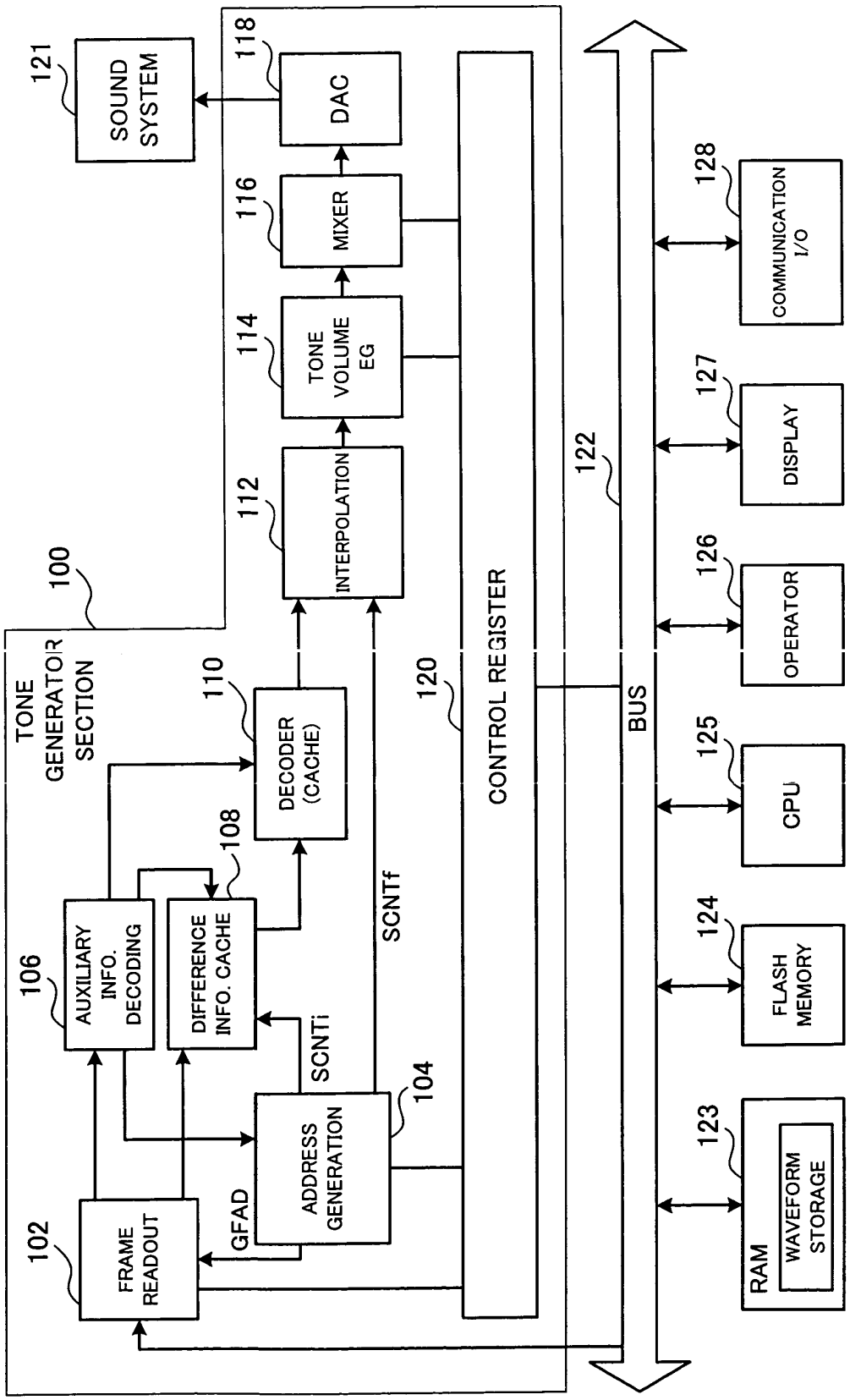
TONE GENERATOR SECTION
100
FRAME READOUT
102
AUXILIARY INFO. DECODING
106
DIFFERENCE INFO. CACHE
108
DECODER (CACHE)
110
INTERPOLATION
112
TONE VOLUME EG
114
MIXER
116
DAC
118
SOUND SYSTEM
121
ADDRESS GENERATION
104
GFAD
SCNTi
SCNTf
CONTROL REGISTER
120
BUS
122
RAM
WAVEFORM STORAGE
123
FLASH MEMORY
124
CPU
125
OPERATOR
126
DISPLAY
127
COMMUNICATION I/O
128

FIG. 12

(a)

	AUXILIARY INFO.	DIFFERENCE CODE		
00	NUMBER OF BITS	1	2	3
01	PREDICTION COEFFICIENT	4	5	6
02		7	8	9
03		10	11	12
04		13	14	15
05		16	17	18
06	QUANTIZATION WIDTH	19	20	21
07		22	23	24
08	OTHERS	25	26	27
09		28	29	30

(b)

K_00-TH SUBFRAME	NUMBER OF BITS	1	2	3		
K_01-TH SUBFRAME	PREDICTION COEFFICIENT	4	5	6		
K_02-TH SUBFRAME	PREDICTION COEFFICIENT	7	8	9		
⋮						
K_09-TH SUBFRAME	OTHERS	28	29	30		
(K+1)_00-TH SUBFRAME	NUMBER OF BITS	1	2	3	4	
(K+1)_01-TH SUBFRAME	PREDICTION COEFFICIENT	5	6	7	8	
⋮						
L_00-TH SUBFRAME	NUMBER OF BITS	1	2	3	4	5	6
⋮						
M_00-TH SUBFRAME	NUMBER OF BITS	1	2			
⋮						

FIG. 14

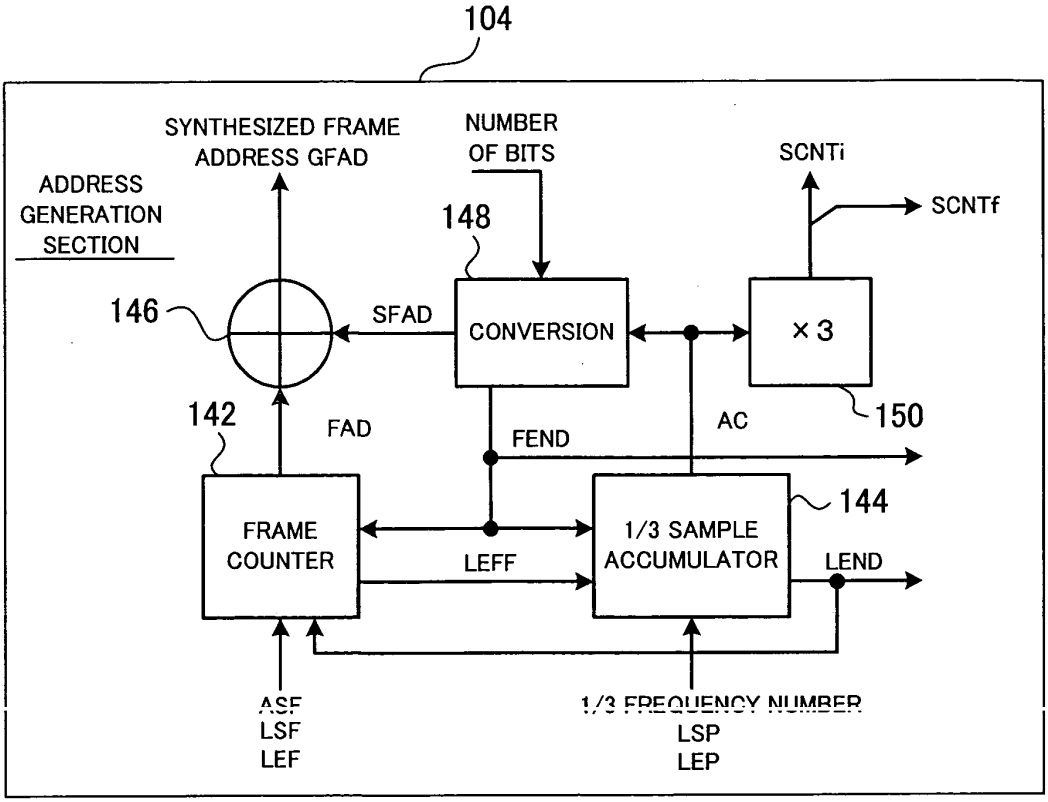
104
SYNTHESIZED FRAME ADDRESS GFAD
NUMBER OF BITS
SCNTi
SCNTf
ADDRESS GENERATION SECTION
148
146
SFAD
CONVERSION
× 3
142
FAD
FEND
AC
150
144
FRAME COUNTER
LEFF
1/3 SAMPLE ACCUMULATOR
LEND
ASF
LSF
LEF
1/3 FREQUENCY NUMBER
LSP
LEP

FIG. 15

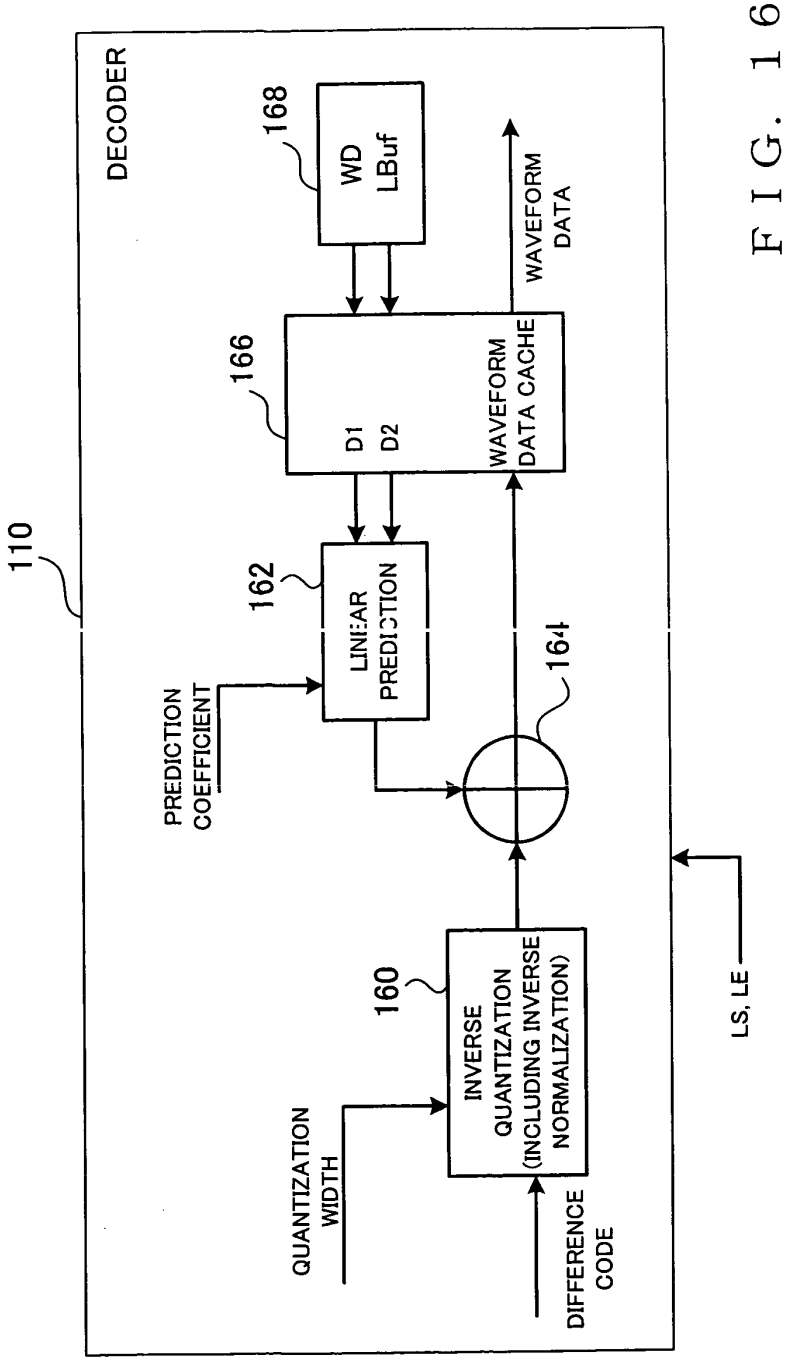
DECODER
110
168
WD LBuf
WAVEFORM DATA
166
D1
D2
WAVEFORM DATA CACHE
162
LINEAR PREDICTION
PREDICTION COEFFICIENT
164
160
INVERSE QUANTIZATION (INCLUDING INVERSE NORMALIZATION)
QUANTIZATION WIDTH
DIFFERENCE CODE
LS, LE

FIG. 16

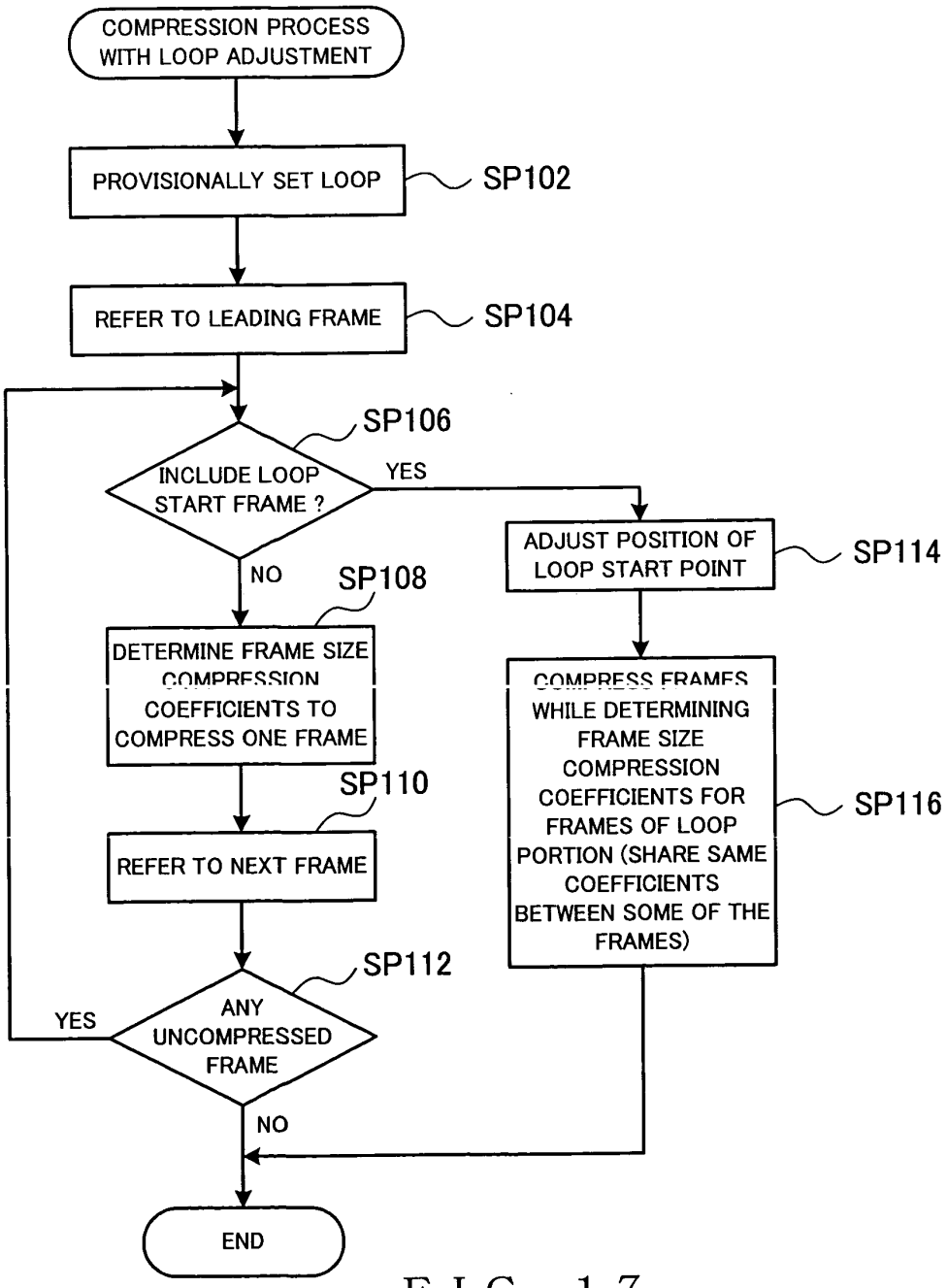
COMPRESSION PROCESS WITH LOOP ADJUSTMENT
PROVISIONALLY SET LOOP
SP102
REFER TO LEADING FRAME
SP104
SP106
INCLUDE LOOP START FRAME ?
YES
NO
SP108
DETERMINE FRAME SIZE COMPRESSION COEFFICIENTS TO COMPRESS ONE FRAME
SP110
REFER TO NEXT FRAME
SP112
ANY UNCOMPRESSED FRAME
YES
NO
ADJUST POSITION OF LOOP START POINT
SP114
COMPRESS FRAMES WHILE DETERMINING FRAME SIZE COMPRESSION COEFFICIENTS FOR FRAMES OF LOOP PORTION (SHARE SAME COEFFICIENTS BETWEEN SOME OF THE FRAMES)
SP116
END

FIG. 17

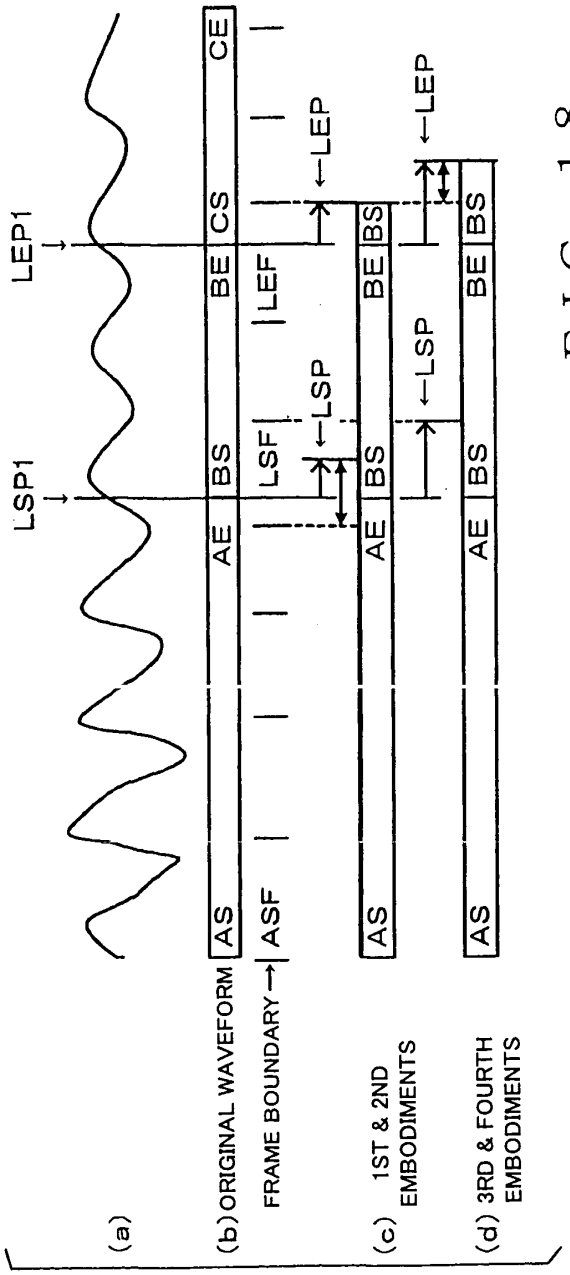
LEP1
LSP1
AS
ASF
AE
BS
LSF
BE
LEF
CS
CE
LSP
LEP
(a)
(b) ORIGINAL WAVEFORM
FRAME BOUNDARY
(c) 1ST & 2ND EMBODIMENTS
(d) 3RD & FOURTH EMBODIMENTS

FIG. 18

(a) CASE WHERE NO LOOP PORTION IS SET

	HEADER	F1	F2	F3	F4	F5	F6	F7	F8
DIFFERENCE CODE		W1	W2	W3	W4	W5	W6	W7	W8
EMBEDDED AUXILIARY INFO.	P1	P2	P3	P4	P5	P6	P7	P8	
APPLIED AUXLLIARY INFO.		P1	P2	P3	P4	P5	P6	P7	P8

(b) CASE WHERE LOOP PORTION IS SET (1ST EMBODIMENT)

	HEADER	F1	F2	F3	F4	F5	F6	F7	F8
DIFFERENCE CODE		W1	W2	W3	W41	W5	W6	W7	W81
EMBEDDED AUXILIARY INFO.	P1	P2	P3	PX1	P5	P6	P7	PX1	P5
APPLIED AUXLLIARY INFO.		P1	P2	P3	PX1	P5	P6	P7	PX1

LSP LEP

(c) CASE WHERE LOOP PORTION IS SET (2ND EMBODIMENT)

	HEADER	F1	F2	F3	F4	F5	F6	F7	F8
DIFFERENCE CODE		W1	W2	W3	W42	W52	W6	W7	W8
EMBEDDED AUXILIARY INFO.	P1	P2	P3	PX2	PX2	P6	P7	P8	PX2
APPLIED AUXLLIARY INFO.		P1	P2	P3	PX2	PX2	P6	P7	P8

LSP LEP

(d) CASE WHERE LOOP PORTION IS SET (3RD EMBODIMENT)

	HEADER	F1	F2	F3	F4	F5	F6	F7	W83 F8
DIFFERENCE CODE		W1	W2	W3	W43	W5	W6	W7	
EMBEDDED AUXILIARY INFO.	P1	P2	P3	PX3	P5	P6	P7	PX3	
APPLIED AUXLLIARY INFO.		P1	P2	P3	PX3	P5	P6	P7	

LSP PX3 LEP

(e) CASE WHERE LOOP PORTION IS SET (4TH EMBODIMENT)

	HEADER	F1	F2	F3	F4	F5	F6	F7	W84 F8
DIFFERENCE CODE		W1	W2	W3	W4	W5	W6	W74	
EMBEDDED AUXILIARY INFO.	P1	P2	P3	P4	P5	P6	PX4	P4	
APPLIED AUXLLIARY INFO.		P1	P2	P3	P4	P5	P6	PX4	

LSP PX4 LEP

FIG. 19

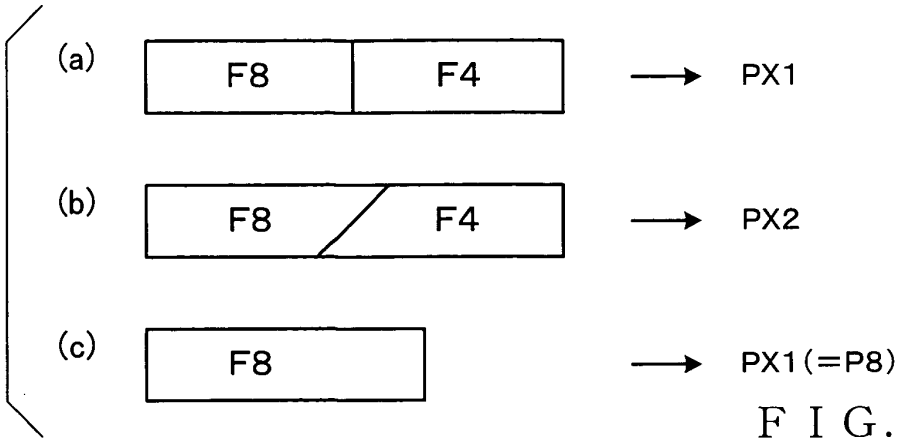

FIG. 20

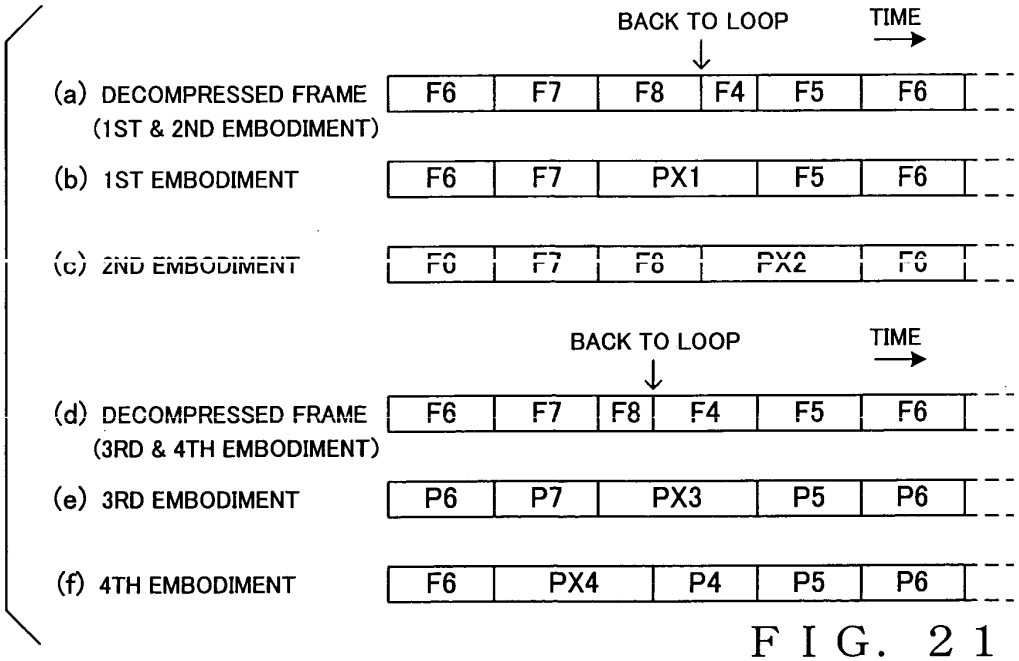

FIG. 21

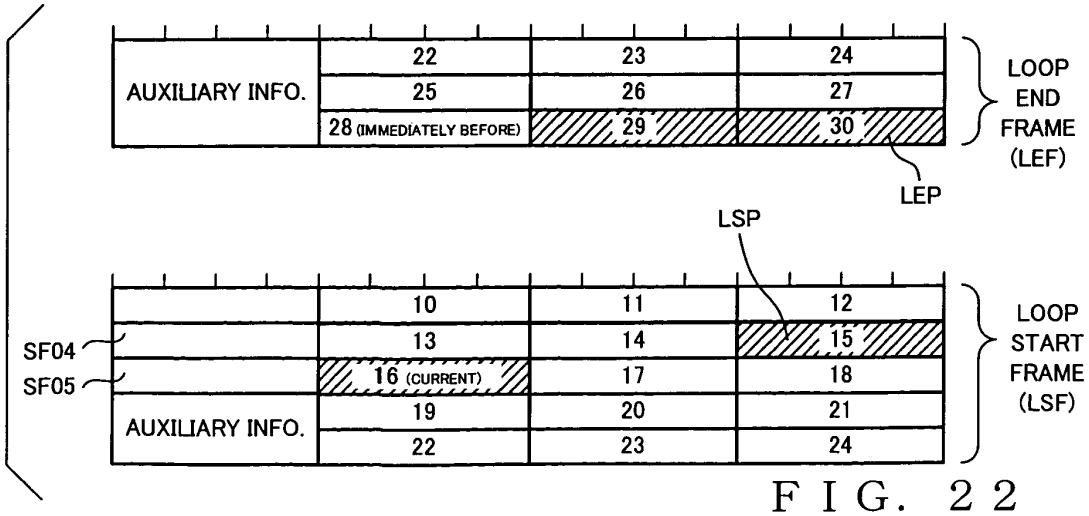

FIG. 22